

# SCIENCE

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

## LEGISLATION RELATING TO STANDARDS.\*

ONE of the first official acts of the National Academy of Sciences, in the capacity of scientific adviser of the government, was the appointment, at the request of the Secretary of the Treasury, in 1863, the year in which the Academy received its charter, of a Committee on Coinage, Weights and Measures, which has continued to be a standing committee of the Academy. The report of this committee in 1866 was one of the effective forces in securing the passage of the most important, and, until recently, the only act of Congress constituting general legislation on the subject of weights and measures. In view of these facts, and on account of the remarkable progress towards unification of standards which has been made during the past few years, affecting in one way or another the whole civilized world, and especially in view of very recent activity and interest in this country, it seems proper to invite the attention of the Academy to a brief resumé of National legislation relating to weights and measures, from the founding of the National Government to the present moment. The task is rendered comparatively easy from the fact, for which metrologists can hardly be too thankful, that such legislation is extremely meager. It is a cause for sincere congratulation that in this respect, at least,

\* Presented to the National Academy of Sciences at its April meeting.

the powers conferred upon Congress by the Constitution of the United States have not hitherto been exercised in full. The importance of investing the sole power of regulating standards of weight and measure in the National government was recognized in the Articles of Confederation and expressed in the Constitution of the United States. The importance of a judicious exercise of that power was emphasized by Washington in his first message to Congress. By direction of Congress, the Secretary of State, Thomas Jefferson, made a report on July 15, 1790, in which he proposed an extremely interesting scheme founded on the length of a uniform rod which would make a single vibration per second when swinging from one extremity.

Jefferson fully appreciated the advantage of a decimal system of weights and measures, and the scheme proposed by him was as purely decimal as that of the Metric System, and in passing from the unit of length to that of volume and mass resembled it greatly. It may be truly said that full credit has never been accorded this, the most accomplished of the fathers of the Republic, for his nearly complete anticipation of the results of the labor of the most brilliant men of the most brilliant period of French science. Jefferson's report was referred to a committee in the Senate which, having learned of the movement toward uniformity in France and other European countries, reported that, in view of that movement, they considered it inexpedient to make any changes in the existing systems. Thus a little more than a hundred years ago the policy of 'waiting for the Metric System' was inaugurated and has practically continued to be the policy up to the present time. Occasional further references to the matter were made in reports, messages, bills offered, etc., during the last years of the last century, but no legislation resulted other than the inspection law of 1799, noted below. At least one

important consequence followed a reference to the desirability of action in the message of President Madison, sent to Congress on December 3, 1816. The paragraph relating to weights and measures was referred by the Senate to the Secretary of State, who was requested to prepare a report in full upon the subject, including such measures 'as may be proper to be adopted in the United States.' Four years later the Secretary, John Quincy Adams, transmitted to the Senate his famous report, which must always be regarded as a classic. For exhaustiveness, elaboration of detail and thoroughness of treatment no other document in any language relating to this subject is comparable with it. While it has been a storehouse of information and argument for all metrologists of later date, it did not result in any very decided action on the part of Congress. "Let them take the one or the other, according to the degree of their courage," Jefferson had said when, in 1792, he proposed two schemes, the one being a patching up of existing systems and the other a sweeping reform through the adoption of a decimal ratio throughout. While no one has appreciated the merits of the Metric System more completely than did Adams, and no one has ventured to praise it more highly, at the end of his splendid contribution to metrological science he reached the rather impotent conclusion that Congress ought to fix the existing systems with the partial uniformity of which they may be susceptible, excluding all innovations for the present, and that consultation with foreign nations should be begun, looking to the future establishment of universal and permanent uniformity. It is difficult to estimate what the lack of courage on the part of a great and far-seeing statesman has cost the people of the United States. The population of the whole country at that time did not exceed ten millions, and a change in standards of measure would have been comparatively easy.

The first act of Congress relating to the establishment of standards of weight and measure was that of May 19, 1828, in which a certain brass troy-pound weight which had been procured in London for the use of the mint at Philadelphia was declared to be the standard troy pound. This standard is well known to all metrologists. It was made by Capt. Kater in 1827, being a copy of the imperial troy pound taken from the House of Commons for that purpose. It is of brass, approximately pear-shaped, and its adjustment was accomplished by the addition of fine wires placed in a cavity in the upper part of the weight. Owing to this peculiarity of construction, it is impossible to know its density, and it has only historical value as a standard.

The next legislation by Congress was in the form of a resolution adopted in June, 1836, directing the Secretary of the Treasury to cause a complete set of all standards adopted by the Treasury Department for use in the custom houses and for other purposes, to be delivered to the Governor of each State of the Union. This was a useful measure, calculated and intended to give effect to the recommendation of Adams fifteen years earlier. It resulted in a tolerably complete uniformity of standards of length and mass throughout the Union.

A quarter of a century now passed without further National legislation on the subject. In the meantime, and especially towards the latter part of this period, the attention of many intelligent people in different parts of the country had been drawn to the great superiority of the Metric System of weights and measures, which had gone into extensive use in Europe, Mexico, Central and South America, and the enormous burden borne by English-speaking people in maintaining the customary standards had begun to make itself evident. As early as 1859, the legislature of New Hampshire urged

upon Congress the necessity for reform and the adoption of a decimal system. Maine followed in 1860 and Connecticut in 1861. In his first annual report as Secretary of the Treasury, Mr. Chase, in December, 1861, again brought the subject to the attention of Congress, and, as already stated, at his request the National Academy appointed its Committee for the consideration of the subject in 1863.

Although matters of greater moment occupied the time of Congress and filled the public mind during the five years following that of 1860, much progress was made towards a rational system of metrology, especially through the active interest of a few individuals and societies. For the final culmination of this agitation in the passage of the Metric Law of 1866, we are unquestionably indebted to Mr. John A. Kasson more than to any other one man. In 1861 Mr. Kasson was appointed First Assistant Postmaster-General by President Lincoln. In this office he became aware of the great embarrassment in the administration of international postal laws arising out of a lack of uniformity of units of weight and currency. Seeking relief therefrom, he originated and represented the United States in the International Postal Conference held in Paris in 1863, on the invitation of Mr. Seward, Secretary of State, which was, in fact, the forerunner of the International Postal Union, organized a little more than ten years later. One of the recommendations of the conference of 1863 was that the Metric System of weights be adopted for postal purposes. Mr. Kasson resigned the office which he held in the Postoffice Department in order to take his seat in Congress in December, 1863. Here his opportunities for advancing the interests of metrological reform were greatly enlarged. Having been appointed to serve on the Committee of Ways and Means and finding that that committee had within its jurisdiction the

subjects of 'Coinage, Weights and Measures,' he sought the creation of a separate committee, which should be exclusively charged with the consideration of these subjects and obtained from the House an order to that effect. Of this important committee, Mr. Kasson was made Chairman, and, beginning as it did, it has, during the thirty years of its existence as a standing committee of Congress, generally been favorable to metrological progress. During the next two or three years Mr. Kasson made an exhaustive study of the subject and did much to concentrate the growing interest in the Metric System and to guide the activity of various scientific bodies, commercial organizations, etc. In a private letter referring to this very important period in the history of legislation relating to standards, he speaks in highest praise of the invaluable assistance rendered by our Associate, Professor H. A. Newton, of Yale University, to whom was committed the task of preparing the tables of relation and conversion which accompanied the report of the committee and which form a part of the statute. In January, 1866, the Committee of the Academy on Coinage Weights and Measures made its report, and on May 17th Mr. Kasson submitted to Congress the report of the committee of the House of Representatives, unanimously recommending accompanying bills and resolutions, which, with a single exception, afterward were enacted into laws, and on July 28, 1866, the use of the Metric System was legalized by Act of Congress for the whole United States, being then and for many years the only system of weights and measures having the authority of National legislation. In the passage of this bill through the House, Mr. Kasson feared opposition, due, as he says, 'to the love of talk,' and to avoid furnishing a text for debate he tactfully declined to make a speech in favor of the passage of the bills and resolutions,

simply offering to answer any questions which might be asked. His policy was successful, and the proposed Act being only permissive and not obligatory in character, the whole matter was disposed of favorably in an hour or two. In the Senate the bill was referred to a special committee, of which Charles Sumner, who took a lively interest in the matter, was chairman. Sumner was generally eager to lead in reforms of this kind, and after mastering the material which was put into his hand he prepared an elaborate and scholarly speech in favor of the measure, which, however, he refrained from delivering, it is believed, on the advice and suggestion of Mr. Kasson. In this speech, which was afterwards printed, in a manner which was somewhat characteristic of the great champion of human liberty and the rights of man, he ignored in a great measure the work of the House Committee on Weights and Measures, if not, indeed, the action of the House, and was lauded by a portion of the public press as the successful first champion of this very important step towards a more advanced civilization. I have gone into these details concerning the Act of 1866 because of the real moment and significance of that Act. Although it produced little if any immediate effect in the way of a beginning in the actual use of the system, the attention of the general public was at once turned to it. Nearly all text-books on arithmetic published since that date have included a treatment of the Metric System, and instruction in its use has been given in thousands of schools throughout the country, thus, in a measure, preparing the way for its final exclusive use. In science quite universally, and in many arts, trades and professions, it has come into general use, to the end that at this moment most intelligent people know something of it. For this there is little doubt that we are largely indebted to the Act of 1866 and the agitation

which followed its passage. The general introduction of the system in the postoffices of the country was contemplated and provided for in Mr. Kasson's Act, and he had ready for future introduction a resolution providing for its compulsory use in the custom houses, thus greatly facilitating its general adoption in trade. His removal from Congress to the Diplomatic Corps of the United States prevented realization of his designs, but metrologists and the public at large should not fail to recognize the splendid services which he rendered in directing the legislation of thirty years ago.

The statutes are silent in the matter of weights and measures for more than a quarter of a century following the Act of 1866. The general trend of public sentiment during this period and the leaning of government authorities towards the final adoption of the Metric System is unmistakably shown, however, in the annual appropriations for the support of the International Bureau of Weights and Measures, to which we were committed as a nation by the International Convention of 1875.

The next legislation relating to standards was an Act, approved March 3, 1893, establishing a standard gauge for sheet and plate iron and steel. This measure is by no means an advance in practical metrology, its enactment being in response to the urgent demands of those actually engaged in the rolling of sheet metal. The influence of the Office of Weights and Measures prevented it from involving certain unscientific and physically impossible conditions, besides securing the use of metric units as well as the pound, foot and inch. It also secured the addition of a 'limit of error' or tolerance, a very important part of practical legislation in metrology, which has hitherto been almost, if not quite, absolutely neglected in this country.

Although not an Act of National legislation, a step of great importance was taken

on April 5, 1893, in the approval by the Secretary of the Treasury of a Bulletin issued by the Superintendent of Weights and Measures announcing the definitive adoption of the International Prototype Metre and Kilogramme as fundamental standards of length and mass and declaring that in the future the customary units, the yard and the pound, would be derived from them, in accordance with the Act of 1866. This put the government of the United States, as far as relates to the operations of all the Departments (with the single exception of the mint, for which the old troy pound remains a standard as explained above), on an international metric basis, all measures in ordinary use being derivatives of the metre and kilogramme.

The next step in metrological legislation was the Act of July 12, 1894, establishing a series of units for electrical measurement. This Act grew out of the recommendation of the International Electrical Congress held in Chicago in 1893. The units which it establishes are all founded on the centimetre, the gramme and the second, and it is distinctly a 'Metric' Act. For the successful management of this important Act, from the time of its introduction in the House, through its reference to the committees in both House and Senate and up to the time of its approval by the President, we are very largely indebted to Hon. Charles W. Stone, member of Congress from Pennsylvania, then a member and now Chairman of the House Committee on Coinage, Weights and Measures, who, by reason of his tastes and training, had an intelligent comprehension of the importance of a measure which was so technical in its character as to be nearly unintelligible to the ordinary legislator. Mr. Stone pressed the bill through its various stages with tact and influence to its final enactment as a law, at a time and under conditions when very little legislation of any kind was possible,

and the obligations under which he has placed metrologists is a matter worthy of record.

Up to the present date this Act completes the list of statutes relating to weights and measures, and it will be seen that in a hundred years only four laws fixing standards have been made. In 1828 the standard of the mint was fixed by law; in 1866 the Metric System was legalized; in 1893 a gauge for measuring sheet iron was established, and in 1894 the units for electrical measurement were defined.

This seems entirely inadequate to the needs of a great nation, and such a condition of things could never have continued had not the several States long ago exercised that authority which by the Constitution belongs to Congress, but which Congress has thus far practically ignored. For reasons already given, this condition is not one to cause regret. It leaves our National law makers to-day practically free from the influence of past legislation, which might be a serious obstacle in the way of following that course which a century of experience has now shown conclusively to be the only wise one.

History shows that marked advances of the character here referred to are usually brought about through the active, personal interest and enthusiasm of a very few men, often not more than one or two. It is true that they must be supported and reinforced by outside influence, but in a matter of this kind it will usually happen that not many members of either House or Senate will have the time or the interest to thoroughly inform themselves of the merits of a measure which does not immediately appeal to them. They depend largely on the few who are well informed, who have made a special study of the subject, and who by reason of their personal character and influence are accepted as authority. A general Act, however, changing either now or at some

fixed future time the whole system of metrology in daily and constant use is something which is likely to challenge opposition and to secure which it will be necessary to give the widest possible range to discussion and criticism.

Such an act is now under consideration by Congress. On December 26, 1895, Hon. D. M. Hurley, of New York, introduced a bill looking to the compulsory adoption of the Metric System within the next few years. It was considered with much care by the Committee on Coinage, Weights and Measures, to which it was referred, and on March 16th the Chairman of that Committee, Hon. Chas. Stone, made, by the unanimous direction of the Committee, an elaborate, interesting and valuable report, recommending the passage of a substitute for Mr. Hurley's bill, involving essentially the same principles, but differing from it somewhat as to details. Mr. Stone, as Chairman of the Committee, has championed the bill on the floor of the House with the same interest and skill that characterised his previous efforts in behalf of a scientific metrology. He has been efficiently seconded by Mr. Hurley and others, to the end that the friends of the measure have much confidence in its final success in the next session of Congress. No more important measure has been considered by Congress for many years and no opportunity to pass a law which will be for the great and lasting benefit of the whole of the people in so great a degree as this is likely to present itself for many years to come.

T. C. MENDENHALL.

NOTE.—The following are the Acts referred to above, except that of 1894, defining electric units, which has already been published in this journal:

Act of Congress of 1799, directing a semi-yearly comparison of weights and measures used in custom houses:

Number of gauge.	Approximate thickness in fractions of an inch.	Approximate thickness in decimal parts of an inch.	Approximate thickness in millimeters.	Weight per square foot in ounces avoirdupois.	Weight per square foot in pounds avoirdupois.	Weight per square foot in kilograms.	Weight per square meter in kilograms.	Weight per square meter in pounds avoirdupois.
0000000	1-2	.5	12.7	320	20.00	9.072	97.65	215.28
000000	15-32	.46875	11.90625	300	18.75	8.505	91.55	201.82
00000	7-16	.4375	11.1125	280	17.50	7.983	85.44	188.37
0000	13-32	.40625	10.31875	260	16.25	7.371	79.33	174.91
000	3-8	.375	9.525	240	15.	6.804	73.24	161.46
00	11-32	.34375	8.73125	220	13.75	6.237	67.13	148.00
0	5-16	.3125	7.9375	200	12.50	5.67	61.03	134.55
1	9-32	.28125	7.14375	180	11.25	5.103	54.93	121.09
2	17-64	.265625	6.746875	170	10.625	4.819	51.88	114.37
3	1-4	.25	6.35	160	10.	4.536	48.82	107.64
4	15-64	.234375	5.953125	150	9.375	4.252	45.77	100.91
5	7-32	.21875	5.55625	140	8.75	3.969	42.72	94.18
6	13-64	.203125	5.159375	130	8.125	3.685	39.67	87.45
7	3-16	.1875	4.7625	120	7.5	3.402	36.62	80.72
8	11-64	.171875	4.365625	110	6.875	3.118	33.57	74.00
9	5-32	.15625	3.96875	100	6.25	2.835	30.52	67.27
10	9-64	.140625	3.571875	90	5.625	2.552	27.46	60.55
11	1-8	.125	3.175	80	5.	2.268	24.41	53.82
12	7-64	.109375	2.778125	70	4.375	1.984	21.36	47.09
13	3-32	.09375	2.38125	60	3.75	1.701	18.31	40.36
14	5-64	.078125	1.984375	50	3.125	1.417	15.26	33.64
15	9-128	.0703125	1.7859375	45	2.8125	1.276	13.73	30.27
16	1-16	.0625	1.5875	40	2.5	1.134	12.21	26.91
17	9-160	.05625	1.42875	36	2.25	1.021	10.99	24.22
18	1-20	.05	1.27	32	2.	.9072	9.765	21.53
19	7-160	.04375	1.11125	28	1.75	.7938	8.544	18.84
20	3-80	.0375	.9525	24	1.50	.6804	7.324	16.15
21	11-320	.034375	.873125	22	1.375	.6237	6.713	14.80
22	1-32	.03125	.793750	20	1.25	.567	6.103	13.46
23	9-320	.028125	.714375	18	1.125	.5103	5.493	12.11
24	1-40	.025	.635	16	1.	.4536	4.882	10.76
25	7-320	.021875	.555625	14	.875	.3969	4.272	9.42
26	3-160	.01875	.47625	12	.75	.3402	3.662	8.07
27	11-640	.0171875	.4365625	11	.6875	.3119	3.357	7.40
28	1-64	.015625	.396875	10	.625	.2835	3.052	6.73
29	9-640	.0140625	.3571875	9	.5625	.2551	2.746	6.05
30	1-80	.0125	.3175	8	.5	.2268	2.441	5.38
31	7-640	.0109375	.2778125	7	.4375	.1984	2.136	4.71
32	13-1280	.01015625	.25796875	6½	.40625	.1843	1.983	4.37
33	3-320	.009375	.238125	6	.375	.1701	1.831	4.04
34	11-1280	.00859375	.21828125	5½	.34375	.1559	1.678	3.70
35	5-640	.0078125	.1984375	5	.3125	.1417	1.526	3.36
36	9-1280	.00703125	.17859375	4½	.28125	.1276	1.373	3.03
37	17-2560	.006640625	.168671875	4¼	.265625	.1205	1.297	2.87
38	1-160	.00625	.15875	4	.25	.1134	1.221	2.69

By a law of Congress, passed in 1799, 5th Congress, 2d Session, it was ordered that "the surveyor (of each port of the United States) shall, from time to time, and particularly on the first Monday in January and July in each year, examine and try the weights, measures and other instruments used in ascertaining the duties on imports, with standards to be provided by each collector, at the public expense, for that purpose; and when disagreements and errors are discovered, he shall report the same to the collector, and obey and execute such directions as he may receive

for the correction thereof, agreeably to the standards aforesaid."—(Statutes at Large, Vol. 1, page 643.)

Revised Statutes of the United States, May 19, 1823:

"Sec. 3548. For the purpose of securing a due conformity in the weight of coins of the United States to the provision of this title, the brass troy pound weight procured by the Minister of the United States at London, in the year eighteen hundred and twenty-seven, for the use of the Mint and now in the custody of the Mint at Philadelphia, shall be the stand-

ard troy pound of the Mint of the United States, conformably to which the coinage thereof shall be regulated."

*Resolved*, by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of the Treasury be, and he hereby is, directed to cause a complete set of all the weights and measures adopted as standards, and now either made, or in progress of manufacture, for the use of the several custom-houses, and for other purposes, to be delivered to the Governor of each State in the Union, or such person as he may appoint, for the use of the States respectively, to the end that a uniform standard of weights and measures may be established throughout the United States.

Approved June 14, 1836.

An Act to authorize the use of the Metric System of Weights and Measures, July 28, 1866:

Be it enacted by the Senate and House of Representatives of the United States in Congress assembled, That from and after the passage of this Act it shall be lawful throughout the United States of America to employ the weights and measures of the Metric System, and no contract or dealing, or pleading in any court shall be deemed invalid or liable to objection because the weights or measures expressed or referred to therein are weights and measures of the Metric System.

Sec. 2: And be it further enacted, That the tables in the schedule hereto annexed shall be recognized in the construction of contracts and in all legal proceedings, as establishing, in terms of the weights and measures now in use in the United States, the equivalents of the weights and measures expressed therein in terms of the Metric System; and said tables may be lawfully used for computing, determining and expressing in customary weights and measures the weights of the Metric System," 1866.

An Act establishing a standard gauge for sheet and plate iron and steel:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That for the purpose of securing uniformity the following is established as the only standard gauge for sheet and plate iron and steel in the United States of America, namely:

[See table previous page.]

And on and after July first, eighteen hundred and ninety-three, the same and no other shall be used in determining duties and taxes levied by the United States of America on sheet and plate iron and steel. But this act shall not be construed to increase duties upon any articles which may be imported.

Sec. 2. That the Secretary of the Treasury is authorized and required to prepare suitable standards in accordance herewith.

Sec. 3. That in the practical use and application of the standard gauge hereby established a variation of two and one-half per cent., either way may be allowed.

Approved, March 3, 1893.

#### THE LACOE COLLECTION IN THE NATIONAL MUSEUM.

THE Lacoe Collection of Fossil Plants, the removal of which from Pittston, Pennsylvania, to Washington, has now been accomplished, is by far the largest and most valuable of its kind in America, and compares favorably with the richest paleobotanical collections in European museums.

Mr. R. D. Lacoe, who has so generously presented this magnificent collection to the Museum, is a leading business man of Pittston, who for twenty-five years has found diversion and outdoor occupation in collecting fossils, and whose enthusiasm in connection with his scientific and practical knowledge of mining has enabled him to bring together a most unique and valuable series of the Paleozoic plants of America.

His interest in the subject is a natural outgrowth of his taste for science, and has doubtless been stimulated by his environment, for he lives in the very heart of the northern Anthracite coal region. To this fact is also in large measure due his interest in paleontological research in general.

The collection contains nearly 100,000 specimens and was shipped in 315 cases, and is constantly being increased through the collecting agencies established by Mr. Lacoe in all the principal coal regions in the United States. The series illustrating the morphology of species and their geographical and geological distribution alone comprises over 17,000 specimens. It represents more thoroughly than any other collection the fossil flora of the Anthracite region of Pennsylvania. There are also especially good

series from the coal fields of Illinois, Tennessee and Missouri, and from other States, besides important collections from Nova Scotia, New Brunswick and Brazil.

The collection has been arranged in the following categories: (1) types and specimens intended for study, (2) exposed slabs suitable for exhibition, and (3) unstudied and duplicate material. Some idea of its bulk may be formed from the fact that it is estimated that 1,000 museum drawers, in addition to six large exhibition wall cases, will be required to accommodate it.

In addition to gathering specimens in the field and labeling them with his own hands, Mr. Lacoe long since engaged the services of collectors in a number of States and the Canadian Provinces, and with their assistance and the purchase of private collections has, by the expenditure of perhaps \$50,000 of his private fortune, succeeded in accumulating this enormous mass of material.

Mr. David White, Assistant Paleontologist of the United States Geological Survey, has devoted many months to the labeling and packing of the collection at Pittston, and since its arrival at the Museum has been almost constantly employed in the work of arranging and cataloguing. Progress has been slow because of the pains taken to authenticate each specimen.

Mr. Lacoe began the formation of the great collection which bears his name, early in the seventies, and upon the organization of the Second Geological Survey of Pennsylvania, in 1878, it had already assumed such proportions that Prof. Leo Lesquereux, the foremost of American paleobotanists, was detailed by the Director of the Survey to study the collection on behalf of the State. The results of his studies, together with descriptions of the larger number of species in the collection, were incorporated by him in his famous work on the 'Coal Flora of the Carboniferous Formation in Pennsylvania and throughout the United States,' pub-

lished as Report P of the Second Geological Survey of Pennsylvania. It is safe to say that nearly one-third of the specimens illustrated in the atlas accompanying the first and second volumes, and the greater part—in fact, nearly all—of those in the third, are in the Lacoe collection.

Owing to the hurried publication of the third and final volume, in compliance with the time-limit for the work specified in the Legislative act, there were many new forms in the collection upon which Lesquereux had not completed his studies. To this number many more have since been added, and a number of drawings have been prepared. Most of these unpublished forms are accompanied by manuscripts in various stages of completion, and in some instances by notes and sketches. The manuscripts have been placed by Mr. Lacoe in the hands of Mr. White, who will assist in revising, verifying and completing Lesquereux's posthumous work for publication. The manuscripts contain descriptions of approximately 125 species or varieties, of which perhaps 80 are new.

The Collection, as far as described, embraces about 750 published *types*, and includes perhaps nearly half of the originals of the American Carboniferous flora. The few others which are still in existence are for the most part in the custody of the university and State geological museums.

A number of these new forms were described by Lesquereux in the Proceedings of the American Philosophical Society, the Catalogue of the Pottsville Scientific Association, and the Reports of the Geological Surveys of Arkansas, Illinois and Indiana, by Prof. D. P. Penhallow in the Proceedings of the National Museum, and by Sir William Dawson in the Canadian Record of Science and in his work on the Fossil Plants of the Devonian and Upper Silurian formations of Canada.

When he gave the plants from the Paleo-

zoic formations, Mr. Lacoe also sent to the Museum examples of the Cretaceous and Tertiary flora of Colorado, studied and partially published by Lesquereux, and an interesting lot of specimens of Triassic and Paleozoic fishes and crustacea, studied by Cope, Hall, Whitfield and others; also a collection of 800 Dakota Group plants, about 125 of which are described by Lesquereux in Monograph XVII. of the United States Geological Survey, on the "Flora of the Dakota Group."

A portion of the Collection will be placed on exhibition, as soon as it can be labeled and installed.

Mr. Lacoe formally offered the collection to the Museum in December, 1891, in a letter to Prof. Lester F. Ward, an old friend and correspondent, expressing his belief that this disposition of it would best insure the fulfillment of his purpose in its formation, which was primarily to bring together in one place as complete a collection as possible of the older fossil flora, for use in scientific research, the conditions imposed being merely that the Collection should be kept entire, with such additions as may hereafter be made to it by exchange of duplicates or subsequent contributions by the donor; that it be known as 'The Lacoe Collection,' and that it be accessible to scientists and students without distinction, provision being made for the proper preservation of the specimens from loss or injury.

The acquisition of this wealth of material makes the National Museum an important reference center for all future comprehensive work in this field. The Lacoe Collection is a noble monument to the public spirit and generous enthusiasm of its founder.

G. BROWN GOODE.

#### NOTE ON THE DEVONIAN PALÆOSPONDYLUS.

IN my review of Dr. Dean's 'Fishes, living and fossil,' I have ventured to suggest an ordinal name for the remarkable *Palæo-*

*spondylus Gunni*, discovered by Dr. Traquair in the Caithness Flagstones. I now give reasons for so doing.

The "*Palæospondylus Gunni*" is a very small organism, usually under one inch in length, though exceptionally large specimens occasionally measure one inch and a-half \* \* \*. It has a head and vertebral column, but no trace of jaws or limbs; and, strange to say, all the specimens are seen only from the ventral aspect, as is shown by the relation of the neural arches to the vertebral centra.

"The head is in most cases much eroded \* \* \*. It is divided by a notch \* \* \* into two parts \* \* \*. The *anterior part* shows a groove the edges of which are elevated, while the surface on each side shows two depressions like fenestræ, though perhaps they are not completely perforated, and also a groove partially dividing off, posteriorly and externally, a small lobe. In front there is a ring-like opening \* \* \* surrounded by small pointed cirri, four ventrally, at least five dorsally, and two long lateral ones which seem to arise inside the margin of the ring instead of from its rim like the others. The *posterior part* of the cranium is flattened, but the median groove is still observable. Connected with the posterior or occipital aspect of the skull are two small narrow plates which lie closely alongside the first half dozen vertebræ."

"The bodies of the vertebræ are hollow or ring-like, and those immediately in front are separated from each other by perceptible intervals; their surfaces are marked with a few little longitudinal grooves, of which one is median. They are provided with neural arches, which are at first short and quadrate, but towards the caudal extremity lengthen out into slender neural spines, which form the dorsal expansion of a caudal fin, while shorter hæmal ones are also developed on the ventral aspect."

Such are the essential features of *Palæospondylus* as recorded by Dr. Traquair in 'The Annals of Scottish Natural History' (III., p. 94-98, pl. 3, 1894). He maintained that "there seems no escape from the conclusion that the little creature must be classed as a Marsipobranch" and that, "if *Palæospondylus* is not a Marsipobranch, it is quite impossible to refer it to any other existing group of vertebrates."

Dr. Dean in a recent note 'on the supposed kinship of the *Palæospondylus*' (SCIENCE, N. S., III., p. 214) claims to have discovered 'a series of transversely directed rays, arising from the region of the post-occipital plates of Traquair' which, in his opinion, 'warrant the belief that this lamprey-like form was possessed of paired fins, a character decidedly adverse to the now widely accepted view of Marsipobranchian affinities.'

In the case of the little animal in question, we have to deal with matters of observation first and then of interpretation. The latter, however, largely preponderate for even what is represented as being seen must be the result of interpretation of traces or filling-up of outlines; of course, then, taxonomic deductions must stand or fall in the ratio of the correctness or failure of the interpretation as well as observation.

Assuming the correctness of Dr. Traquair's description and figures, we certainly have a remarkable combination of characters. On the one hand, if the 'median opening or rim' is indeed nasal, the animal certainly cannot be referred to the class of Selachians or of Teleostomes. On the other hand, the cranium and the segmented vertebral column indicate a more advanced stage of development of the vertebrate line than that from the living Marsipobranchs must have originated. We may, therefore, with propriety isolate it as the representative not only of a peculiar family (*Palæospondylidae*), but of an order

or even subclass (Cycliæ) of vertebrates which may provisionally (and only provisionally) be retained in the class of Marsipobranchs.

The group may be defined as Monorrhines with a continuous (?) cranium, a median nasal (?) ring, and a segmented vertebral column.

The name Cycliæ has been constructed on the model of the classical names *Acanthias*, *Anthias*, *Xiphias*, etc., and is derived from κύκλος circle, and the termination -ιας, i. e., cyclias in the plural number. The word is descriptive and will fit, whatever interpretation may be put on the ring-like structure.

The differences between the Hyperoartia and Hyperotreta are very great, and Prof. Lankester did not go much too far when he elevated those groups to class rank. Among the numerous distinctive characters are the great differences in the auditory organs. Perhaps the organs of *Palæospondylus* might be worked out in some specimen and throw light on the subject of affinities. At present even the region of the auditory organs is not exactly known and we are now at a loss to orient the several parts of the cranium. In fact, the question of the relations of *Palæospondylus* is a very open one.

THEO. GILL.

[Just after this note had been sent to SCIENCE, and when the review of Dr. Dean's 'Fishes' was in page form, I had the pleasure of receiving from Dr. Dean an extract from the 'Transactions of the New York Academy Sciences, Vol. XV., pp. 101-104, plate V.,' entitled 'Is *Palæospondylus* a Cyclostome?' Dr. Dean concludes that "the position of the fossil \*\*\* is certainly undefinable," but suggests that "perhaps one might most reasonably place it with the Ostracoderms among the curiously specialized off-shoots of the early chordates."]

THE CULTURE GIVEN BY SCIENCE.

To be a man of broadest culture is a high ideal. Fortunately, the idea and the associations conveyed by this word 'culture' are still of the finest, the noblest. But when scanned in the new light of the present, has not the flower of culture, like everything else of the best, gained a living heart of science, taken on the pure, high, unfading colors of science, the benign empress of our modern world? And with this change has not culture developed a firmer moral fiber from the inexorable, inevitable insistence of science on a moral courage in her votaries which would sacrifice all unflinchingly in the pure cult of truth?

Before the age of science the man of the then culture was, as his fellows, in fear of being known to have been wrong.

Said Lowell: "There are three short and simple words, the hardest of all to pronounce in any language (and I suspect they were no easier before the confusion of tongues), but which no man or nation that cannot utter can claim to have arrived at manhood. These words are, *I was wrong*."

Even Goethe, the very highest type of culture not based on a core of science, even Goethe, with his calm and coldness as of the immortals, with his magnificent appetite and digestion, even Goethe mouths and sulks and rants like a stupidly obstinate boy when even his friends declare that in the explanation of colors he is wrong and the man of science, Newton, is right. He snarls and spits to the very last, and, like his countryman, Hegel, makes himself disgusting by blaspheming Newton.

Says J. H. Stirling, Hegel's devoted apologist: "One thing, however, he will not think excusable even in a Hegel: this letter's unsparing bitterness of tone to him—Newton—whom as a productive thinker mankind have so much reason sincerely to thank and supremely to honor."

Says Helmholtz: "To give some idea of

the passionate way in which Goethe, usually so temperate and even courtier-like, attacks Newton, I quote from a few pages of the controversial part of his work the following expressions, which he applies to the propositions of this consummate thinker in physical and astronomical science—"incredibly impudent;" "mere twaddle;" "ludicrous explanation;" "but I see nothing will do but lying, and plenty of it."

Nothing could more exactly illustrate the change of heart which culture has undergone. Could any one imagine Justus von Liebig berating Pasteur for overthrowing utterly Liebig's theory of fermentation?

The friends of Darwin bemoaned the inestimably valuable time which he habitually gave to considering the weakest objections of the feeblest objectors, and even to setting forth and clothing all objections with his own strength.

The culture given by science is strikingly characterized by equipoise of mind, impartiality of view, freedom from obscurations due to selfishness, a taking of self objectively.

This comes in part from the fact that high scientific instruction or attainment cannot be divorced from scientific investigation.

Thus, in Germany, the leader of modern culture, "a university professor is both a teacher and a scientific investigator, and the latter is considered the more important." "Again, when a professor is mentioned the question is asked: What has he written? What are his scientific achievements?"

The culture given by science relegates to the moribund institutions of tradition the old hypothesis that truth is given and fixed, and needs only to be transmitted unchanged. We have seen in our own generation changes accepted and made part of regular university instruction which are so deep-reaching as to under-cut the knowledge thought fixed for twenty centuries. Witness the non-Euclidean geometry and evo-

lution. The watchword of modern scientific culture is independence of thought and investigation, "Whatsoever is, may be wrong!" Its most cherished palladium is freedom to think, freedom of research, freedom in teaching.

To break a bond restricting liberty to search and say the truth may be more important than killing a definite positive error. The culture given by science can tolerate no distinct dogmatic brand.

A pertinent illustration is found in the attitude of the highest culture now toward language and language teaching. It is found that language, like the expression of numbers by symbols, has attained a higher state by taking aid from space concepts, by making definitely fixed use of position as significant.

The inflectional languages, such as Latin and Greek, correspond to their writing of numbers. There is a hint at some use of position. Witness IV. and VI., or the difference of emphasis given by position in the Latin sentence. But this is like confining the use of steam to the blowing of whistles. Compare 10 and .01, or a few English sentences with their Latin translations. Like the Hindoo discovery of the zero and consequent modern arithmetic is the organic use of position in language as typified by English.

Again, the number system of every child is at first *one, two, many*. The third number, the indefinite, takes different forms, 'some,' 'a few,' 'a lot,' etc. But the mental step from knowing *two* up to knowing *three*, recognizing a class or aggregate as just exactly possessing the distinctive quality *three*, as being triple or a triplet, is a slow and long and difficult step. In the high-bred, smart American child this step represents roughly a whole year's development, which cannot be much hastened.

Now, just this child stage, with the enormously undue importance which it attaches

to the number two, is represented by the whole Greek language and grammar. This speech has a whole system of grammatical forms, called duals, whose creation rests wholly on the baby mistake, the child misconception of *two*. To babies and to Greek grammar *two* is still a god in a trinity.

A modern writer speaks slightly of 'the aping and prolonged caw called grammar, the cackling of the human hen over the egg of language,' but may not the laborious puerilities which have so long passed current as Latin and Greek grammar be of interest to the scientist in comparative child study? "A single scientific idea may germinate into a hundred arts."

GEORGE BRUCE HALSTED.

AUSTIN, TEXAS.

#### CONVENTION OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

THE American Society of Mechanical Engineers held its annual spring convention at St. Louis recently, discussed a number of valuable papers, visited many points of interest and enjoyed informal meetings for social purposes. The papers were less numerous than usual and included fewer very striking or novel communications than ordinarily.\* The convention was fairly well attended and very greatly enjoyed by all who took part.

The Secretary of the Society, Prof. Hutton, presented a discussion of the catalogue system proposed for engineering libraries. Dewey's 'Decimal Classification' was considered a model difficult to excel for general purposes. For an engineering collection, however, further classification is required, and the writer of the paper proposed a special scheme including twenty-two heads, each covering a division of engineering science or art. To these were appended about

\* The papers will appear in the Transactions of the A. S. M. E., Vol. XVII., 1896.

a dozen other heads to cover accessions in the fields of general literature, more or less of which is found in every technical collection. The schedule is very complete and was thought a most satisfactory one.

Mr. Murray offered a paper on 'Structural Steel Fly Wheels.' The rapid increase in the employment of 'high-speed' engines, especially in electric light and power stations, where great irregularity of load is usual, has made the 'running away' of engines a comparatively frequent occurrence, and accidents of great importance are not unusual, involving loss of life and great destruction of property. The weakness of the older type of fly wheel, due partly to the fact that it is constructed of cast iron, partly to its inefficient connection of parts, makes it liable to go to pieces at a comparatively low speed, and gives but small margin above the ordinary working speed. Where, as is probably not very uncommon, an engine, when suddenly deprived of load, jumps up to double speed before the governor can act, or at a time, as is also not unusual, when the governor is not acting, the old cast-iron wheel is very sure to go to pieces and to produce the effect of an exploding giant bomb-shell. Various constructions of wrought-iron and steel wheels have been introduced, and Mr. Murray described a steel wheel made of open-hearth structural steel of about 60,000 pounds tenacity, and built up of a series of discs forming the hub, of a pair of dished disks constituting the main portion of the wheel in place of the ordinary arms, and a rim composed of heavy steel boiler plate; all rivetted together in such manner as to give a factor-of-safety, as computed by the writer of the paper, of twenty-six. All details are given and the construction fully described.

Prof. Goss exhibited the effect of long connections upon the action of steam in the steam-engine indicator and on the diagram, as experimentally determined by

him. He found that even short pipe connections were likely to invalidate conclusions drawn from the diagram regarding the character of the expansion and compression line or the quality of the steam. For usual lengths of connection the area of the diagram will be greater than that of a true diagram, though that area may vary in either direction from the proper dimensions. To secure reliable results the indicator must be attached to the steam cylinder by very short and perfectly straight pipes.

Mr. Whitham described the recent 'mechanical stokers.' Of late years the supply of fuel to the furnace of the steam-boiler and the management of the fire has been effected by the employment of these machines, which, very various in form, all have the common function above described. Their advantages, when successful, are their adaptability to the cheap fuels; their reduction, in large 'plants,' of the cost of labor, by about forty per cent.; their economy of use of fuel, and the constancy or uniformity of conditions of combustion which lies behind the last-named advantage. They are, however, costly, both in manufacture and in repairs, are dependent upon the action of a steam-engine and a steam-blast, and are necessarily dependent, also, upon special skill on the part of the attendants. Anything going wrong, the whole establishment may come to a standstill.

Several forms of stoker are described and their performance, as ascertained by trials, tabulated. A number are found to be efficient for special cases, each in its own province. The engines use a fraction of one per cent. of the steam made; the fans demand three to five per cent., and the steam blasts from five to eleven per cent. in the cases described. The 'stoker' is less adaptable to a fluctuating demand for steam than is hand-firing; but it is constant in maintenance of a fire in good order, and

saves handsomely when operated under favorable conditions on a large scale.

Prof. Carpenter described a new form of steam 'calorimeter' employed at Sibley College, Cornell University, in the determination of the 'quality' of steam. It consists simply of a small chamber, jacketed with steam, a water-glass gauge and a specially graduated pressure gauge. Discharge takes place through a 'standard orifice,' and the gauge indicates the flow in the unit of time. The separated moisture is collected in the reservoir, and its weight is compared with that of the indicated volume of dry steam discharged, to give a measure of the original quality of the vapor. The instrument had been in use about a year, in the form described, and found very accurate and satisfactory after prolonged comparison with the familiar forms of apparatus employed for the same purpose.

Mr. Alberger presented an account of a 'self-cooling condenser' for use where condensing water for the steam engine is difficult to obtain or costly. These systems of cooling the water of condensation for repeated use in a circulation comprehending the condenser and a cooling tower or other device for the removal of the heat taken up from the steam, are coming rapidly into use in many localities. That described consists of a tower in which is installed a large mass of tiling, over which the water circulates and in the midst of which large volumes of air are circulated by the action of a fan blast. A steam-pump circulates the water from condenser to the top of the tower and back in a continually moving stream flooding the tiling; drawing water from a well or tank at the foot of the tower, and passing it through the condenser and then through the masses of tile in the cooling tower, the water finally falling into the well after its temperature has again been reduced to the minimum. The fan requires

less than two per cent. of the power of the main engine; it may not exceed one per cent. The heat is carried away mainly by evaporation into the rising current of air from the fan. The cost is stated at about that of one pound of water per horse power per hour as used in the engines, including all expenses of steam-making.

Mr. Kent discussed the definition of steam-boiler 'efficiency,' as that term is now applied in connection with the boiler-trials made under the now usual forms of standard tests. The paper indicated the nature and extent of the difficulties arising in the endeavor to obtain the unit of measurement, and in its application to the numerical rating of boiler efficiencies; showing that the uncertainties introduced through the inaccuracy of existing methods of measuring the total heating power of a fuel, and in thus obtaining a basis of comparison, might be so great as to preclude any possible uniformity or accuracy of measurement of the true efficiency of the boiler. Two illustrative cases were presented in the paper. The heating power of a coal was reported by two different systems of calorimetric measurement, as respectively, 13, 302 and 14, 620 from different calorimeters, and, in the other case, 13,799 and 16,212 B. T. U. per pound. The boiler thus received credits for efficiency, ranging from 56.66 to 66.37 in the one case, and from 73.12 to 85.83 in the other, accordingly as one or another calorimeter was employed to do the work of measuring the 'actual' heating power of the fuel.

Prof. Thurston presented a paper on 'Superheated Steam; Facts, Data and Principles Relating to the Problem of its Use.' The nature of superheated steam, its thermal and thermodynamic properties and its value in the steam-engine were studied. Its only use to-day is that of reducing internal wastes by 'cylinder condensation,' through the process of supplying sufficient

heat to the cylinder wall to check that initial loss. It has no thermodynamic value, in a proper sense, as it does not increase the range of adiabatic expansion. The economical value of superheating and of 'reheating' between the cylinders of the multiple-cylinder engine was discussed, and illustrations were given from the reported results of engine trials, showing that superheating is more effective than other expedients for the prevention of internal waste. By reference to experiments reported in large numbers on the value of heat transferred to the steam by steam-jackets for the same purpose, the conclusion was drawn that for each unit of heat expended in the prevention of this waste several could usually be saved in the engine. For simple engines this ratio of saving to expense amounted to an average of six and seven; for compound engines, to between three and four, the gain being the less as the engine is the more economical originally. Experience in Europe, far more than in the United States, affords fact and datum for the conclusions reached. The Schmidt superheating engine, reported upon by Schroeter, of Munich, gives the horse power on but 10.2 pounds of steam per hour; the pressure being about 125 pounds and the engine one of moderate size. The little twenty-horse-power engine of Sibley College, operated with 300 to 500 pounds of steam, as elsewhere described, is here stated to give the horse-power, the steam being saturated at the high-pressure cylinder and reheated between cylinders with 'less than ten pounds, 11,000 B. T. U., per horse power per hour.' The conclusion is reached that "This is, to-day, the greatest of all the problems presented to the designing and constructing engineer, with the possible exception of that of finding a system of effectually rendering the interior of the working cylinder non-conducting in such manner as to entirely prevent the occurrence of initial condensation; thus conforming the 'ideal case'

to the real, and making the steam engine a purely thermodynamic machine."

A number of papers were read describing details of practical engineering work and a set of 'topical questions' was propounded; both papers and questions eliciting much interesting discussion bearing upon practical, rather than scientific, points in engineering.

#### CURRENT NOTES ON ANTHROPOLOGY.

##### THE SCIENCE OF LANGUAGE.

WITHIN the compass of about 300 duodecimo pages, Prof. Giacomo de Gregorio, of the University of Palermo, has compressed an admirable survey of the elements of the science of language, a task by no means easy. ('Glottologia.' Ulric Hoepli, Milan, 1896.)

He divides the subject into three parts, glottology, language in general, and particular languages. In the first he discusses the place of the study of language among the sciences, and rapidly sketches its historic development, naming the most prominent students and their works. The second part enters fully into the phonetics and the physiology of articulate sounds, and in a second chapter reviews the theories of linguistic radicals and the origin of speech. The third part presents an able chapter on the various proposed classifications of languages, and a summary of the principal linguistic stocks of the globe. An excellent bibliography of linguistic writings precedes the text.

The author is much more than a compiler. He is an independent and acute critic, and threads his way with clear vision through the dust and fog of conflicting hypotheses and averments. He is not a supporter of any 'school,' but claims for linguistic science the high and right place that it deserves among the natural sciences relating to man, and his method is that of those sciences.

## ETHNOLOGY AND HISTORY.

WHEN the science of ethnology shall be properly understood, the application of its methods to the sociologic development of the human race will lead to an entirely novel plan of writing history, and to a different appreciation both of its motives and its aims. That which has long been sought for under the attractive name of 'The Philosophy of History' will be found to be nothing more than a series of ethnologic deductions; and 'The Mission of the Historian' in its largest sense will be nothing more than the application of the natural science of man to the welfare of man; nothing more but that will be the greatest achievement which the human species will have witnessed, far transcending any mere material gains or discoveries which it has made or can make.

At the last annual meeting of the New Jersey Historical Society I delivered by request an address upon this subject, which has since been published. A limited number of copies remain by me, which I shall be glad to send to such readers of *SCIENCE* as may apply for them. (Address, Media, Penna.)

## PRIMITIVE COSMIC CONCEPTIONS.

SLOWLY but surely the theory that similarities of mythical concepts betokened ancient intercommunication is giving way to the true explanation that such similarities are owing to the unity of the human mind and the sameness of its processes.

No one has taught this profound truth more positively than Prof. Bastian, the eminent director of the Ethnographic Museum of Berlin. Very lately he has published a most instructive work of about 200 pages entitled, 'The Thought Creation of the Surrounding World out of Cosmogonic Conceptions.' (Dümmler, Berlin.) It treats of the various so-called 'elements' which make up the myths of religions, the beliefs

and notions of his surroundings, real and imagined, which every man forms unconsciously to himself, and which deeply influence his life and works. Such are his views about the divine, the soul, death, spirits, creation, magic, etc. These and a hundred others develop similarly in similar stages of culture, and the parallel schemes drawn from culture-horizons far asunder which the author lays before the reader are striking and convincing.

It would be very desirable if Dr. Bastian's remarkable studies on this and allied subjects could be brought in a compact shape before the English reading public.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

## NOTES UPON AGRICULTURE AND HORTICULTURE.

## DISEASES OF CITROUS FRUITS IN FLORIDA.

THE orange industry is a large one in the warmer portions of our country and the citrus fruits have several diseases which cause annual losses of not less than a half million dollars. In order to obtain good control of these diseases and check their ravages the government has had a station of research in Florida for the past three years, and Bulletin 8 of the division of Vegetable Physiology and Pathology just issued is a report of progress by Messrs. Swingle and Webber at the Subtropical Laboratory. The bulletin commends itself at sight, being attractive in plates, three of which are colored, and the text is carefully prepared. Six diseases are considered, namely: (1) Blight, (2) Die-back or Exanthema, (3) Scab or Verrucosis, (4) Sooty Mould, (5) Foot-rot and (6) Melanose.

The blight, probably contagious, the cause of which is yet unknown, seems to be incurable; therefore affected trees should be burned. Die-back is due to malnutrition and improper drainage and culture. Brown eruptions appear upon the twigs

which afterwards die, and the fruits split and drop before maturing. It is an advantage to withhold organic nitrogenous manures. The scab attacks lemons and sour oranges and disfigures the foliage and fruit by producing warts. It can be prevented by spraying with fungicides. Sooty mould is a fungus following the attacks of insects and fumigations to kill the insect prevents it. Foot-rot is the most destructive malady and is recognized by gum exudation at the base of the tree. The cause is probably some minute organism and prevention is found by cutting away the diseased parts and washing with fungicides. Melanose is a new disease of all citrous fruits, not yet very destructive, the cause of which is unknown, but Bordeaux mixture is a satisfactory remedy.

#### COMBATTING CARNATION RUST.

THE growing of carnations is a large industry in this country, but is beset with many vicissitudes not among the least of which is the carnation rust. This trouble has been under investigation at some of the experiment stations, and before us lies bulletin No. 100, of the New York Experiment Station, with the title as given above. Mr. Stewart, the author, has tested the germination of the spores of the rust fungus in various substances, and finds, for example, that a 1-100 solution of copper sulphate is much too weak to prevent germination. When common salt is used 1-45 is the strongest solution in which the spores can grow. The spores, on the other hand, are remarkably susceptible to the action of potassium sulphide, a 1-3,000 solution entirely preventing germination. A similar series of results was obtained by soaking cuttings in the above solutions, those in potassium sulphide being unharmed. Attempts to cure rusty plants by spraying with fungicides failed, but good results were obtained in preventing its appearance

upon healthy plants. Rust, it has been shown, will spread among mature plants. It is important that carnation plants be held up from the ground by inverted V's of wire netting. For unknown reasons, some varieties are much more susceptible than others to the rust.

#### POTATO DISEASES UPON LONG ISLAND.

IN addition to his carnation investigations Mr. Stewart has made a study of potato diseases, the results of which appear in Bulletin No. 101, of the New York Station. In addition to the good results following from spraying with the Bordeaux mixture for the blights, notes are given upon an internal browning of potatoes, the cause of which is not determined. The brown spots are entirely surrounded by healthy tissue, and cultures made from the discolored portions produced no growth. Under the microscope the brown spots give no clue as to the cause of the trouble, and it would seem to be physiological and not mycological in its origin. Field experiments indicate that the browning is not transmitted from seed to product, but the discolored tubers are not the best to use for planting. There are several stem blights of potatoes, but Mr. Stewart finds another which seems to strangle the plant and working internally will be a difficult one to check. A new fusarium (*F. acuminatum* E. & E.) is reported.

BYRON D. HALSTED.

RUTGERS COLLEGE.

#### SCIENTIFIC NOTES AND NEWS.

##### ASTRONOMY.

A MEETING was held at Paris last month which will be of the greatest importance to the progress of astronomical science. Each of the four nations whose governments publish elaborate astronomical ephemerides were represented at this meeting. The object of the conference was the discussion of the best system of astronomical constants, with a view to the introduction

of uniformity in the various astronomical ephemerides.

The French ephemeris was represented by MM. Faye and Loewy; the British by Dr. Downing and Dr. Gill; the German by Prof. Bauschinger, and the American by Prof. Newcomb and Dr. Backlund, director of the Russian National observatory. Dr. Bakhuyzen and M. Trépied acted as Secretaries.

The delegates succeeded in deciding upon definitive constants of nutation, aberration and the solar parallax. The values adopted for these constants are those deduced by Dr. Gill from heliometer observation of the minor planets Victoria, Sappho and Iris.

The determination of the constant of precession and the formation of a catalogue of standard stars was left to Prof. Newcomb.

There can be no doubt that the introduction of uniformity in the four great national astronomical ephemerides will bring about a great improvement in the reduction of astronomical observations in general, and will do away with a great deal of confusion which now exists.

H. J.

#### THE GREENWICH OBSERVATORY.

WE learn from the London *Times* that the Astronomer Royal, Mr. H. M. Christie, has presented his annual report to the Board of Visitors. The most important event of the year has been the completion of the north wing and central octagon tower of the new Physical Observatory and the reerection upon this tower of the Lassell dome. When finished it will consist of a central octagon tower surmounted by a dome, from which will radiate four wings running due north, south, east and west, built of red brick faced with terra cotta. The completion of the east and west wings has now been sanctioned, and provision has been made in the estimates for commencing the work during the present year. Within the dome upon this handsome new building will eventually be placed the 26-inch photographic telescope presented to the Royal Observatory by Sir Henry Thompson, and now nearly finished and ready for inspection at Sir Howard Grubb's works in Dublin. As a guiding telescope the old Merz 12 $\frac{1}{2}$ -inch telescope, which used to be called the Great

Equatorial, and that not many years ago, will be remounted, and in place of a counterpoise on the other side of the declination axis will be mounted a Cassegrain reflecting telescope of 30-inch aperture, also the gift of Sir Henry Thompson, for which Dr. Common has undertaken to figure the mirrors and to supervise the construction. Another handsome new building also built of red brick and terra cotta, with its dome, was completed early in January, and houses the altazimuth, or universal transit circle, which will very shortly be ready for use. The lighting of this dome, as well as that of the old Lassell dome, by a series of port hole windows clearly points to the Argus-eyed character of the instruments within.

The report contains important details regarding the management and scientific work of the observatory. In concluding his report the Astronomer Royal says: "The reorganization of the staff of the Observatory which has been referred to in the two last reports, and which has now been approved, will provide the much needed increase in the permanent staff of trained observers and in the supervising power by the appointment of an additional chief assistant. The benefit of this increase of permanent staff will, it is hoped, be felt in the future, but during the past year the work of the Observatory has had to be carried on by a reduced staff, there being three vacancies in the staff of five second-class assistants which could not be filled up, as under the scheme now sanctioned six established computers are to be appointed in lieu of three second-class assistants. Under these difficult circumstances (aggravated by the inconvenience arising from the building operations in progress) it is highly creditable to the assistants and computers that the record of work for the past year compares so well with that of any previous year, and I take this opportunity of acknowledging the zeal and energy with which the whole staff has worked to maintain the credit of the Observatory."

#### GENERAL.

PROF. W. L. ELKIN, of Yale University, has been elected by the Yale Corporation director of the observatory.

THE division of ornithology and mammalogy

of the department of agriculture will after the first of July be entitled the Biological Survey, at the head of which Dr. C. Hart Merriam will remain. An important part of the work of the Survey will be the determination of zoological and botanical zones, which have already proved so important economically and scientifically.

THE United States Fish Commission steamer Albatross, with the Bering Sea Commission, created to make an exhaustive study of the life and condition of the fur seals in Bering Sea, sailed from Seattle, Wash., for the north, on June 24th.

ACCORDING to the plans of the Geological Survey for the field work of the present season, five parties will work throughout the summer in the New England States and eastern New York, five in the Appalachian region, two in the coastal plain from the mouth of the Hudson to the Gulf of Mexico, five in the interior or Mississippi region, four in the Rocky Mountain region, and eight in the Pacific region.

THE new library of Pratt Institute, Brooklyn, was dedicated on the afternoon of May 26th with addresses by Mrs. Margaret Deland, Truman J. Backus and Melvil Dewey. Charles M. Pratt, President of the Trustees, made an interesting statement of the work of the library. The cost of the building was \$190,000. It is finely appointed in every respect and admirably adapted to its purpose. The new iron stack has been pronounced by many the most attractive and satisfactory of any yet built.

WE regret to record the death of Sir Joseph Prestwich, professor of geology at Oxford University. He was born near London on March 12, 1812, and was educated at University College, London. He was President of the Geological Society, 1870-72; Vice-President of the Royal Society, 1870-71; President of the International Geological Congress, 1888; Corresponding Member of the Paris Academy of Sciences; D. C. L., of Oxford University, etc. He was eminent for his researches in geology and related subjects such as the 'Antiquity of Man,' 'Sub-marine Temperatures,' 'The Water Supply of Cities,' etc.

WE have not hitherto noticed the death of

M. Jules Simon, as he did not himself make contributions to science. His philosophical publications are, however, of value, and he accomplished much for the advancement of science in France. In view of the conditions of political life in America, France may be congratulated that it could have for Premier and for one of its most prominent statesmen a man such as Jules Simon.

ACCORDING to the annual custom, the second of the receptions of the Royal Society, which was held at Burlington House on June 11th, was a ladies' *Conversazione*. The exhibits were in large measure the same as at the preceding conversazione, which we have already noticed, and there will further be a public exhibition of a number of these, lasting about two weeks, at the Science Museum at South Kensington.

ACCORDING to the announcement of the publishers, a new scheme for arctic exploration will be described in *Appletons' Popular Science Monthly* for July, by Robert Stein, of the United States Geological Survey. The chief features of the plan, which has been commended by many experienced explorers, are that the work shall be continuous and that it shall have a base of supplies reached every year by the whalers. Mr. Stein accompanies his statement with an interesting map of the arctic regions, showing what has been done by recent expeditions and how much remains unexplored. It is proposed to initiate the new undertaking in 1897.

DR. PAUL M. JONES, instructor in natural history and geology in Vanderbilt University, is spending the summer on the southern coast of Florida, studying the marine life of that coast and of the Bahama Islands, and collecting specimens for the biological museum and laboratory of the University.

ADVICES received at London from Berbera, East Africa, under date of May 25th, show that Prof. Daniel Elliot, who left London in March last for Somaliland, has returned to Berbera from the Eolas Mountains. He intends to start at once for the interior with a large caravan. All his party are well. He has thus far met with much success in his search for specimens of the fauna of the country for the Field Museum at Chicago. Some of the ani-

mals obtained by him and prepared by the taxidermist of the party are very rare.

THE periodical comet discovered by Mr. W. B. Brooks on July 6, 1889, whose orbit has been computed by Dr. S. E. Chandler, Prof. Chas. Lane Poor and others, has been detected by M. Javal, one of the assistants of the Observatory of Nice.

THE Josselin Botanical Society of Maine will hold its second annual meeting at Farmington on July 7th to 10th, 1896. The first two days will be devoted to the reading of papers and discussions and the last two to field expeditions in the surrounding country. Further details regarding the meeting may be obtained from the Secretary, Mr. M. L. Fernald, Cambridge, Mass.

IN an article contributed to the *Naturwissenschaftliche Rundschau* Dr. L. Fomm, of Munich, states that he has secured interference effects with the X-rays and has found their length to be about 0.000014 mm.

DR. CHARLES MARGOT has recently investigated (*Arch. des Sciences phys. et nat.*) the curious colors of the alloys of aluminium. White metals usually give white alloys, but 78 parts of gold and 22 parts of aluminium give an alloy of a brilliant purple color, and 72 parts of platinum and 28 parts of aluminium give a bright yellow alloy. The author holds that these alloys are true chemical combinations. They might prove useful for coins, except that the structure is crystalline and the alloy turns to powder when struck by a blow.

M. A. RIVOIRE has recently described before the Paris Academy an instrument that automatically transcribes a composition played on the piano. The record is said to be as legible as the ordinary musical notation, and it might be an advantage to a composer to directly record his compositions. It would also show the exact rate at which a composer or performer plays a given piece, our ordinary musical notation being deficient in this respect.

AN English magistrate has recently decided that it is illegal to sell green peas colored with copper sulphate. It is said that about twenty

million tins containing these peas are consumed annually in Great Britain. They are also sold extensively in America, and the makers should be required at least to state the amount of copper sulphate that they contain.

AN expedition for the purpose of boring to a considerable depth into the atoll of Funafuti in the Ellice group (lat. 9° S., long. 179° W.) left Sydney on May 1st, on board H. M. S. Penguin, a surveying vessel, under command of Captain Field, R. N. Prof. W. J. Sollas, of Trinity College, Dublin, and the Geological Survey of Ireland, is in chief charge as geologist, and with him are Mr. Stanley Gardner, of Cambridge, and Mr. Hedley, of the Australian Museum, who will be doing biological work and collecting. The department of mines of the New South Wales government is lending diamond drill plant and giving some monetary aid as well, while Prof. Anderson Stuart, Mr. Slee and Prof. David have given much time and thought to the expedition. The main funds are provided by the British Government Grant Committee and by the Royal Society, while the Admiralty are providing a ship to carry men and apparatus from Sydney to the island and back to Fiji, where the expedition will disperse. Although the work is surrounded by many difficulties, and possibly by unforeseen ones which may prevent the carrying out of the complete program, it is hoped that a section through a considerable part of an atoll at sea level may be obtained sufficient to show the constituent rocks, the foundation on which they rest, and possibly the exact method according to which the atoll has been built up. It is hoped that the work may be completed before October.

A REUTER despatch to the London *Times* states that the steam yacht *Windward* left St. Katharine Docks yesterday afternoon for Franz Josef Land. The *Windward*, which is now under the command of Captain James Brown, an Arctic explorer of over 36 years' experience, is taking out as ice master Mr. John Crowther, who has already made the return journey to Franz Josef Land on three occasions. All told, her crew consists of 22 officers and men. Since her return from Franz Josef Land the *Windward* has been strengthened throughout,

has been practically reëngined, and, in order that additional warmth may be secured, has been lined with three thicknesses of felt. She is taking out a very large supply of provisions, a number of sledges, and two additional members to the Franz Josef Land party. The Windward does not go out on this occasion for the purpose of bringing Mr. Jackson home. She will call at Vardö, when, after embarking sheep, coal and live reindeer, she will sail direct for Franz Josef Land. Four or five days after leaving Vardö she will get into the ice belt, which will probably be of 300 miles width. It is hoped she will get through this in about a fortnight, and it is anticipated that she will communicate with the explorers at Cape Flora, Franz Josef Land, on or about July 20th. As soon as the Windward has discharged her cargo she will leave Franz Josef Land with news of the doings of the explorers, and as she is bound, owing to the ice conditions, to sail before August 20th, she may be expected in England by the end of September. About this time next year, if all has gone well, she will leave London again to bring the explorers home.

PROF. WM. H. BREWER contributes to the Yale Scientific Monthly an account of the observations he has made during the past 45 years on earth tremors at Niagara Falls. The heaviest vibrations were on either side and near the Horseshoe Fall. They disappeared in places in the soft shales below the limestone, although they were evident in the harder beds of limestone and sandstones interstrated with the shales. Passing down the river along the brink of the gorge, the vibrations rapidly decreased in intensity, becoming too faint to be perceived between the two suspension bridges, increasing again on nearing the rapids. It is a popular belief of persons living near the Falls that crystals are more common in the rocks there than elsewhere in the same formation. But macroscopic examination of limestones taken near the Falls and those gathered a few miles away did not show that the crystallization or the texture of the rocks had been affected by the jar of the cataract. As Prof. Brewer remarks, it would be interesting to make the investigation microscopically, and to study the jar of the cataract with proper instruments.

#### UNIVERSITY AND EDUCATIONAL NEWS.

THE *Oxford University Gazette* for June 9th contains the eighth annual report of the delegates of the University museum (1895). It will be remembered that two important changes were made during that year, Mr. Francis Gotch having succeeded Dr. J. S. Burdon-Sanderson as professor of physiology, and Mr. Henry A. Miers having succeeded Prof. H. M. Storey Maskelyne as professor of mineralogy. The principal improvement in the museum building during the year was the alteration and fitting up of two rooms in the department of medicine for a pathological laboratory, the cost of the scientific installation of which has been defrayed out of a sum of £500 presented by a benefactor who does not wish his name to be made public. Prof. Sanderson, the Regius professor of medicine, on his resignation of the physiological chair presented to the laboratory instruments to the value of £105, made under his direction during his tenure of the chair, and paid for by him in excess of the departmental income. The fine portrait of Prof. Burdon-Sanderson, painted in 1893 by the Hon. John Collier, has been presented to the department by Mrs. Burdon-Sanderson.

THE June examination under charge of the University of the State of New York was the largest in the history of the department. About 400,000 question papers were required, all of which were printed in the department by its own employees. The preliminary examinations for professional and technical students, and those for license to practice were so large that the accommodations heretofore in use proved insufficient. Besides the 69th regiment armory in New York City it became necessary to use two large assembly rooms in the New York University building in Washington Square.

IN response to an appeal by the Chancellor at the annual banquet of the alumni of Vanderbilt University, twenty-six of those present made subscriptions of one hundred dollars each to endow a chair in the University. An endeavor will be made to increase the amount to \$50,000 within the next year. The annual address before the University body was delivered by Postmaster-General William L. Wilson.

WILLIAM T. MAGRUDER, M. E., adjunct professor of mechanical engineering in Vanderbilt University has resigned and has been elected professor of mechanical engineering in the Ohio State University.

SCIENTIFIC LITERATURE.

*The Jack Rabbits of the United States.* By T. S. PALMER, M. D., Assistant Chief of Division. Bulletin No. 8, U. S. Department of Agriculture, Division of Ornithology and Mammalogy, Washington. Government Printing Office. 1896. 8vo., pp. 84, 6 pll. and frontispiece and 2 text figures.

No jack rabbits are found in the United States east of about the 95th meridian; west of this line they are of almost universal distribution, sometimes several species occurring over the same area. They extend northward over the plains of the Saskatchewan, and southward into Mexico far beyond our southern border. The extent of their abundance and the amount of injury they are capable of doing to growing crops is little known to the general public, outside of the jack rabbit area. In Bulletin No. 8, of the Division of Ornithology and Mammalogy of the U. S. Department of Agriculture, a vast amount of information is given on both these points, both statistically and pictorially, Dr. Palmer having treated his subject with great thoroughness, and in a way at once interesting to the naturalist and the general reader. The matter is non-technical and relates to the habits and distribution of the five or six species (no attempt is made to discriminate the subspecies) found in the United States, including their abundance and rapidity of increase; their injury to crops and the means of protection against them, and the methods of destruction employed to reduce their numbers. There is also a chapter on 'Rabbit Drives and Hunts,' and another on the value of jack rabbits as game.

In respect to the abundance of these animals over certain areas, Dr. Palmer gives some striking statistics. For instance, he states that in Modoc county, California, 'nearly 25,000 jack rabbits were said to have been killed in three months on a tract of land only six by eight miles in extent.' "A still more remarkable case has been recorded in the San Joaquin Val-

ley. Some of the early drives near Bakersfield took place on a ranch less than one square mile in extent. In the first drive, on the afternoon of January 2, 1888, 1,126 rabbits were killed; as soon as the animals were dispatched, the same field was passed over again and 796 more killed. A week later, on January 10th, there were two drives on the same ground, the first resulting in the destruction of 2,000 rabbits, the second in more than 3,000; in the latter an adjoining field was also driven over. It was estimated that altogether about 8,000 rabbits were killed on this ranch in nine days. The 'Kern County Echo' of March (8?) 1888, stated that a total of about 40,000 rabbits had been killed in the drives about Bakersfield from January 1, 1888, up to that date, and referred to an estimate that two-thirds of the rabbits killed in the drives were females and the average number of young of each of these was 3½. On this basis it was computed that had these 40,000 rabbits lived two months they would have increased to 135,000. When it is considered how much injury a single rabbit can do, the damage which such an army of rabbits is capable of inflicting would hardly be less than that caused by a grasshopper plague." In another place Dr. Palmer states that "it has been estimated that five jack rabbits consume as much as one sheep."

As means of protection rabbit-proof wire fences are sometimes resorted to, and poisons are occasionally used to reduce the number of rabbits; many are also shot, but the chief dependence is wholesale destruction by drives. These are described at length, and illustrated by cuts and some striking reproductions of photographs of some of the remarkably effective drives made about Fresno, in California, where in one instance 20,000 rabbits were killed in a single drive. In the larger drives hundreds of men and boys participate, some on foot but many on horses. It is said that in one drive near Fresno, resulting in the death of 15,000 rabbits, 2,000 horsemen took part. A list of 155 rabbit drives in California is given, with a map showing their location. These drives resulted in the destruction of nearly 400,000 rabbits during a period of about eight years. Lists of drives made in Oregon, Utah, Idaho and Colorado are also given.

The jack rabbits have at present little commercial value; their skins are used to some extent for furs, and many of the animals are sent to the markets of the larger cities and sold as food. It is estimated that some 600,000 are annually consumed in the United States, the greater part being sent to the larger Eastern cities. It is believed that "commercial utilization is the most promising and least expensive method of keeping these pests in check in localities where they are unusually abundant; but returns from this source will only partially offset the losses sustained on account of injuries to crops."

"In America," says Dr. Palmer, "the rabbit question never has, and probably never will assume the proportions it has assumed in Australia. The jack rabbits of the United States are all indigenous species and ordinarily are held in check by natural enemies and by disease. Although local conditions may sometimes favor their temporary increase, yet natural agencies aided by the persistent and constantly increasing war of extermination are gradually, but none the less surely, diminishing their numbers."

Incidentally some account is given of the rabbit pest in Australia, New Zealand and Tasmania, due to the introduction of the common rabbit of Europe (*Lepus cuniculus*), about thirty years ago, for purposes of sport. As is well known, they multiplied so rapidly as to become soon a very serious pest. Dr. Palmer cites statistics showing that about \$5,500,000 had been expended prior to 1888 for their destruction, and in building several thousand miles of rabbit-proof fences for the protection of crops.

J. A. A.

*Catalogue of Fossil Fishes of the British Museum.*

Vol. III. By ARTHUR SMITH WOODWARD, F. C. S., F. Z. S.

Since the publication of the first volume of this series the student of vertebrate morphology, not less than the specialist, has felt that he was to be indebted to Mr. Arthur Smith Woodward for an admirable text-book on the entire subject of Fishes. Critics have universally commended the catalogue, from its general plan down to the details of its text figures and

plates, a work which only could have been written by one who has had the long experience, the broad judgment, to say nothing of the industry, of its author.

The volume which has recently appeared deals with those groups of fishes popularly known as Mesozoic Ganoids, and reviews this subject in such a way that the fourth volume of the series, beginning with the 'Teleosts,' may complete the catalogue. It is understood that a supplementary volume will thereafter be published to supply omissions and to bring the entire subject up to date. Those only who know the confusion which has existed in our knowledge of extinct Ganoids—confusion due to a large and scattered literature, faulty nomenclature, imperfect and partial study—can appreciate the degree of order which has been infused into the entire subject by the present work. Indeed, one may well believe that this volume could not be possible had its author not felt it necessary to visit every noteworthy collection, at home and abroad, for the purpose of making comparison of his material.

The present volume begins with a review of the structural relations of the following groups: the Palæoniscoids of the Trias, *Catopterus* and *Dictyopyge*; the Protospondyli, *Semionotids*, *Macrosemiids*, *Pycnodonts*, *Eugnathids*, *Amiids*, *Pachycormids*; the Aethospondyli, *Aspidorhynchids*, *Lepidosteids*; the Isospondyli, *Pholidophorids*, *Leptolepids*. Then follows the catalogue proper, a careful review of the systematic side of the subject, with complete reference lists and descriptions, illustrated by numerous text figures. Among these are a number of new and admirable restorations, including those of *Dapedius*, *Cleithrolepis*, *Eugnathus*, *Caturus*, *Hypso-cormus*, *Aspidorhynchus* and *Leptolepis*. There are also eighteen plates illustrating those specimens in the Museum which prove of especial interest. A careful review of the book brings out clearly that the treatment of the subject is a purely morphological one, and that the most recent studies on the modes of evolution have been brought into good use. General conclusions have, in the majority of cases, been drawn from the study of progressive series, as, for example, where the author shows that "the most advanced stage of the endoskeleton (of *Neor-*

*hombolepis* and *Otomilla*) is attained in the latest members of the race with the least modified exoskeleton or when he notes that at the time the jaw elements become more simplified among the Teleostomes, a 'new vigor' is apparently infused into their race, marked by the outcrop of a varied series of families. By this means parallelisms have been largely evaded, but of these many interesting examples are cited, as the structures arising in the *Semionotids* and *Macrosemiids*, which are clearly interpretable as the result of similar physiological needs. And it was only after the closest scrutiny that the author was inclined to follow the lead of Prof. Cope in selecting fin structures as the most constant elements in comparison. The old tenets of classification, the characters of scales and even of vertebral axis, were found to be of decidedly minor importance, in the case of scales, as in *Eugnathus* and *Caturus* of not more than generic value. Throughout the volume phylogenetic views are seldom expressed definitely, for even the splendid series of forms which the author has been able to study has not convinced him, in the majority of cases, of more than probable kinships; thus we learn that the "origin of the Chondrostei is still entirely obscure," or that "it seems most reasonable in the present state of knowledge to place the Oligopleuridæ with the (Pholidophoridæ) near the base of the Iso-spondylic Series," or, again, that, "if speculation were permitted in seeking the direct ancestors of the Pycnodonts, it might be most profitable to turn toward the earliest Mesozoic fishes of the *Colobodus* type."

Mr. Smith Woodward regards his volume as acceptable 'merely as a convenient basis for further research, full of imperfections which each specialist will readily discover for himself.' But when one is familiar with the researches of its author, and knows, moreover, that the present volume embodies four years' diligent work, we may naturally expect that its sins, either of omission or commission, will not prove formidable. If criticism must be found one might be inclined to regret that the number of text figures, especially restorations, were not larger, although be it understood that from the obvious nature of the catalogue this number is already a goodly one. BASHFORD DEAN.

*The Cyprinodonts.* By S. GARMAN. Memoirs of the Museum of Comparative Zoölogy at Harvard College. Vol. XIX., No. 1, pp. 179, pls. XII. 1895.

The present monograph on the 'top minnows' has been based upon Mr. Garman's studies of the remarkable—possibly the most complete—collection of these forms, that of the Agassiz Museum at Harvard; and it is certainly one of the most valuable of recent contributions to the study of Fishes. It is important to the systematist, because there is scarcely a group of recent Teleostomes which has stood in greater need of critical revision, for the Cyprinodonts are not merely a large and scattered group, profusely and often very imperfectly described, but one whose species present a most confusing range in coloration, dentition and sexual characters.

One cannot help feeling that in the systematic portion of the work Mr. Garman's studies of the variation among members of each species have enabled him to interpret 'specific' differences with modern broadness, and that the order which has been drawn out of the tangle of synonymy (where a single form had, for example, been placed by various authors in as many as a half dozen 'genera') is one which will prove of permanent value. The monograph is one which, like that on the Discoboli, does fitting justice to its author's careful work; it might well be taken as a model of thoughtful preparation. The plates are admirable examples of the work of the artist and of the lithographer, and especially interesting are Pls. IX.-XII., which were drawn by Sonrel for the elder Agassiz.

The wide range in structural characters which the Cyprinodonts have evolved has been brought out clearly in the introductory portion of the monograph, but perhaps not as fully as many morphologists would desire. But the arrangement of the material with a view of sketching broadly the evolutionary problems suggested by this group is certainly satisfactory. And there can be no doubt that many well-trained morphologists will here learn, for the first time, that sexual dimorphism—where the males or females of the same species will be either sinistral or dextral—may occur among

vertebrates. And on the evidence of cyprinodonts it must be admitted that several of the characters which have been almost universally regarded as stable landmarks in morphological studies should be given comparatively little definite importance. For in this group, ranking only as a *family*, oviparous and ovoviviparous forms have been evolved, together with a broad range in intromittent organs and in embryonic nutriment. So that, for example, we must admit that structures like the 'claspers' of sharks are of but little moment in separating the phylum of the elasmobranchs from that of the Dipnoan or of the Teleostome. In the morphological portion of his work Mr. Garman has directed especial attention to varietal changes, notably in the case of *Fundulus heteroclitus*, and to structural variation as shown principally in teeth, digestive tract, urinogenital system and vertebral column. Under the latter head he attributes the decrease in the number of vertebrae of fishes in general, in and toward the torrid zone, to the 'lessening of the comparative activity of the species,' due to an enlarged food supply and to a decreased need of nutriment, the decreased number is not, therefore, attributable to the direct action of temperature, as several writers appear to have inferred.

BASHFORD DEAN.

A NEW DETERMINATION OF THE RELATIVE  
DENSITIES OF OXYGEN AND HYDROGEN  
AND OF THE RATIO OF THEIR  
ATOMIC WEIGHTS.

To one familiar with the work of Prof. Morley on this subject it would seem that any one who wishes to add anything to our knowledge of the matter must be an experimenter of unusual ability, and must be willing to expend a very large amount of labor on his determinations. That Julius Thomsen, who has recently published the results of his experiments in this field,\* is an experimenter of unusual ability every one will admit. That the results obtained can carry with them any considerable weight in comparison with those of Prof. Morley is very doubtful. It is, however, of very considerable interest to find that, by the use of

\* Zeit. für Anorg. Chem. 11, 14; and 12, 1.

comparatively simple apparatus and by methods differing in almost every detail, he has obtained results which are in fairly close agreement with those of Prof. Morley's elaborate researches.

The method employed for the determination of the ratio of the atomic weights consisted in the determination, first, of the ratio between the weight of a certain amount of aluminium and of the weight of hydrogen evolved by its solution in a strong solution of caustic potash, and, second, of the weight of oxygen required to burn the hydrogen evolved by the solution of a known weight of aluminium.

The density of hydrogen was determined by measuring over water saturated with hydrogen, the gas evolved by the solution of a known weight of aluminium. The density of oxygen was determined in a similar manner, the gas being evolved by the decomposition of potassium chlorate. The volume of gas measured was approximately one and one-half liters, while Prof. Morley measured a volume of hydrogen amounting to *forty-two* liters. The results obtained were:

Ratio of Atomic Weights	1:15.8690±0.0022
Density of hydrogen at 0°, 760 mm. and 45° Lat.	0.089947 ±0.000012
Density of oxygen "	1.42906
Prof. Morley's values were:	
Ratio of Atomic Weights	1:15.879 ±0.00032
Density of hydrogen at 0°, 760 mm. and 45° Lat.	0.089873 ±0.0000027
Density of oxygen "	1.42900 ±0.000034

In discussing the result of his determination of the ratio of the atomic weights, Prof. Thomsen remarks that, as he has avoided the weighing and measuring of large volumes of gases, it is probable that his result is nearer the truth than that obtained by others, and that the uncertainty does not extend beyond the fourth decimal. He seems to have overlooked the fact that, in his syntheses of water, Prof. Morley weighed his hydrogen absorbed in palladium, and also weighed the water formed by its combination, and that, while he weighed the oxygen in gaseous form, the sum of the weights of oxygen and hydrogen agreed almost exactly with the weight of the water.

It is noticeable that Prof. Thomsen's density of hydrogen is higher than that of Prof. Morley, while his ratio for the atomic weights is lower. This seems to indicate that the hydrogen obtained by Prof. Thomsen was contaminated with a trifling amount of some impurity. From the experiments of Prof. Morley it seems probable that hydrogen evolved by the solution of aluminium in potassium hydroxide containing a small amount of the carbonate would contain carbon. As no account is given in the paper of any attempt to exclude the presence of potassium carbonate, or if any experiments to prove the absence of compounds of carbon or of other impurities in the hydrogen used, it is, at least, possible that the difference in the results of the two workers is due to this cause.

To one familiar with the character of such work it is rather a matter of surprise that the difference is not greater.

W. A. NOYES.

*A Dictionary of Chemical Solubilities, Inorganic.*

By ARTHUR MESSINGER COMEY, PH. D.  
8mo. Pp. 515. London and New York,  
Macmillan & Co., 1896.

The attempt is made in this book to give reliable data concerning the solubility of all inorganic substances that had been analyzed before March, 1894.

"The solubility of the substance in water is first given, the data being arranged chronologically in the longer articles. Then follow the specific gravities of the aqueous solutions, and also any data obtainable regarding their boiling points; other physical data concerning solutions are not included. Following this is the solubility of the substance in other solvents—first, the inorganic acids; then alkali and salt solutions, and finally organic substances."

The theories of solution are not discussed, the term 'soluble' being used to indicate that "a solution of some sort has been formed."

The plan of the book is admirable and, so far as our examination has extended, there are no serious omissions. The arrangement of the compounds and the nomenclature adopted are satisfactory and, probably, as good as any that could be employed.

A synchronistic table of periodicals is added

in an appendix as well as some formulas and tables for the conversion of various hydrometer scales into specific gravity.

The work is a worthy successor to the earlier volume of Prof. Storer, and the author deserves the thanks of his colleagues for the time and labor he has put upon it.

L. B. HALL.

SCIENTIFIC JOURNALS.

AMERICAN CHEMICAL JOURNAL, JUNE.

*On the Specific Gravities of Mixtures of Normal Liquids:* By C. E. LINEBARGER. The methods used to determine the molecular masses of liquids, which consist either in converting the liquid into the state of vapor and determining its specific gravity in this condition, or in determining the change in freezing- or boiling-point of a solvent upon the addition of the liquid, do not throw much light on the molecular complexity of the substance in the liquid state. From work in other lines it is probable that in some cases the molecular aggregate is the same in the liquid as in the gaseous condition; but in other cases the complexity increases as the substance passes from the gaseous to the liquid condition. The present paper is a study of the changes in specific gravity which take place when liquids which suffer no change in passage from one state of aggregation to another are mixed. In cases where association or dissociation takes place the number of factors which enter into play is so great that no general conclusions can be drawn. In the determinations pycnometers of a special form were used, and in most cases great precautions were taken to secure pure substances. If two liquids of different chemical composition are mixed, the volume of the resulting liquid will not be equal to the sum of the volumes before they were mixed, but will be greater or less. This is explained by the fact that dilution diminishes the molecular attraction and the internal pressure. The number of molecules in the unit of surface decreases and the volume increases. In this paper the observed and calculated results for a large number of mixtures are given; but the data at command at present is not sufficient to enable one to draw any general conclusions.

*Dianthranol—A Dyhydroxyl Derivative of Dianthracene:* By W. R. ORNDORFF and C. L. BLISS. When anthranol in benzene solution is exposed to the sunlight crystals, having the same percentage composition as the anthranol, but differing in other ways, separate out. The substance can also be obtained by boiling the anthranol for a long time in xylene, and by shaking a solution of anthranol in caustic potash, in contact with the air. The determinations of the molecular weight show that it has twice that of anthranol. A crystallographic study of the crystals shows also that this substance is different from anthranol. Some derivatives were also made and studied. The formation of a diacetyl derivative shows the presence of two hydroxyl groups, and the authors consider that it is made up of two molecules of anthranol, in which the two hydroxyl groups are intact. They think that the union takes place by the breaking of the para bond between the two  $\gamma$ -carbon atoms and the joining of the groups.

*Bromine Derivatives of Metaphenylene Diamine:* By C. LONG JACKSON and S. CALVERT. In the course of an investigation of the behavior of tribromdinitrobenzol, the authors tried the action of tin and hydrochloric acid in hopes of either replacing some or all of the bromine. The number of cases on record, in which the bromine has been replaced by hydrogen when treated with this reducing agent, is small. As the result of work contemporary with this, Schlieper concludes that the bromine which stands in the ortho position to two negative groups is replaced in this manner; but the authors of this paper find this not to be strictly true, for they succeeded in replacing all three bromine atoms in tribromdinitrobenzol, a result not in accord with the above mentioned theory. They conclude that the ortho position, while not absolutely necessary, is yet very favorable for the replacement. The cause of the easy replacement is probably due to the fact that there are other radicals attached to the benzene ring, but their nature does not affect the result. They made several bromine derivations of phenylene diamine and also salts of these products.

*On the Halogen Derivatives of the Sulphonamides:* By J. H. KASTLE, B. C. KEISER and E. BRAD-

LEY. The authors find that chlorine and bromine derivatives of the sulphonamides can be prepared; but up to the present they have not been able to obtain similar ones containing iodine. These substances are somewhat similar to the acid chlorides and are also unstable, exploding when heated rapidly. Their composition can be explained in two ways, as they can be regarded either as addition—or substitution—products of the sulphonamides. The authors consider the evidence to be in favor of the latter, for not only do they show an analogy to nitrogen trichloride in their instability, but they are good oxidizing agents and are easily decomposed by acids. The easy evolution of chlorine is explained more readily by the substitution theory. If it is an addition product we should expect the chlorine to come off in combination with hydrogen, which it does not do. Just as nitrogen trichloride reacts with hydrochloric acid to form ammonium chloride and chlorine, so these products react to form the amide and the halogen.

*The Reduction of Copper Sulphide:* By DELIA STICKNEY. The author finds that copper sulphide can be readily reduced by allowing it to come in contact with the Bunsen flame. If the substance is heated in a crucible the reduction is always incomplete. The addition of some sulphur to cupric and cuprous oxides facilitates the reduction to metallic copper.

This number contains a review of the work done in the field of carbohydrates during the last year, and a physical-chemical study of the Gas Battery.

Brief reviews of the following books are also given in this number of the *Journal*. *Elektro Metallurgie*, Dr. W. Borschers; *Lehrbuch der Elektrochemie*, Dr. M. Le Blanc; *Laboratory Experiments in General Chemistry*, Chas. R. Sanger; *A Short Course of Experiments in General Chemistry with Notes on Qualitative Analysis*, Chas. R. Sanger; *The Scientific Foundations of Analytical Chemistry, treated in an Elementary Manner*, W. Ostwald; *A textbook of Gas Manufacture for Students*, J. Hornby; *The Elements of Chemistry*, P. C. Freer; *Repertoire des Réactifs Spéciaux, Généralement Désignés sous leurs Noms d'Auteurs*, Jean et Mercier. J. ELLIOTT GILPIN.